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SUBURBAN SEWERAGE SYSTEMS

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1957

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[1957]

Safe disposal of sewage in a suburban area from the time the first house is built until the development is complete is one of the most complex problems in modern housing. Provision of satisfactory sewage facilities in a residential development tends to be taken for granted. However, only by careful planning and close cooperation between builders and public authorities can a course of action be taken that will insure orderly development of the sewerage system as the community grows.

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IMPORTANCE OF PLANNING

A sound, comprehensive master sewerage plan should be developed for the suburban areas of every population center in the country. To be of maximum benefit the master plan must include individual plans

for each drainage basin and for each significant sub-basin in the metropolitan area. The plan should give as much, or more, attention to the future development of the area as it does to the immediate problems that have resulted from a decade of unorganized growth. Working from a comprehensive plan, the builder and the health authority can determine for each group of new houses the sewerage arrangement that will best serve to develop the over-all plan in an orderly step-by-step manner.

At present only a few communities have such a master sewage collection and disposal plan. The complexity of governmental organization in metropolitan areas is a frustrating obstacle to unified planning. For maximum benefit, plans should ignore political boundaries and be drawn on the basis of natural drainage areas, but sanitary engineers, and other authorities hesitate to look beyond the boundary of the political unit for which they are responsible. Even where master plans for other services have been made, or are in the making, the problem of collection and treatment of sewage remains, largely because it has been ignored. The house-building industry can serve its own interest and be of incalculable service to the community by urging, demanding, and sponsoring unified action toward sewerage planning.

In some communities, persistent, dedicated leadership has resulted in cooperative action of local governments, formation of special districts, and organization of privately sponsored watershed protective associations. At considerable cost in terms of time and talent, some builders have assumed leadership in these endeavors. Considering the potential economic gain and prestige, builders all

over the country would be justified in spearheading the attack for unified sewerage plans in their communities. Because of the specific circumstances in each community, demand for a unified sewerage plan is most effective when it originates at the local level.

Whether a master plan does or does not exist, in selecting a site for residential development the prudent developer will consider the sewage disposal problem before purchasing the land. Realizing the importance of early consideration many health departments are willing to discuss alternate solutions and give prior approval to satisfactory schemes. With this type of cooperation it is possible to take options on land with purchase contingent on approval of the sewerage plan by the health department or other regulatory authority.

GENERAL SOLUTIONS

There is no universally acceptable solution for sewage disposal in rapidly growing suburban areas. Rather, there are a number of methods that can be employed. The usefulness and the limitations of each method should be reviewed in light of specific circumstances, and that method which can be financed and which shows the most promise as a step towards an eventual permanent solution should be selected. There is danger in advocating one solution to the exclusion of all others, and conversely no useable solution should be discarded on the basis of previous abuse or improper use.

Although there is no agreement on the acceptability of all methods, there are four general sewage collection and disposal plans

in common use. In order of preference these can be summarized as follows:

(1) Connection to an existing publicly financed sewerage system. When it is possible, this is by far the most satisfactory arrangement.

(2) Construction of a privately financed community system. This plan is generally conceded to be the best alternate to (1), but the degree of acceptance varies widely from state to state, and there is need for basic knowledge to assure proper design and use of small systems.

(3) Construction of a treatment system for each house with "on-lot" disposal of the effluent in the soil. This method can be satisfactory only where proper soil conditions prevail and where effective control of design, construction, and use can be assured.

(4) Provision for individual treatment systems for each house with disposal of treated liquid to storm drainage. This method is highly controversial. It is accepted in a few localities, outlawed in many, and the possibility of an injunction or civil suit exists even where the practice is not expressly forbidden.

Need for Technical Advice: Within these four general methods are innumerable possible variations. As previously stated, the best arrangement can be found only by taking into consideration all of the specific conditions which exist for each situation. The experience and knowledge of state and local health departments are indispensable resources for this determination.

No plan should be adopted except on the advice of competent persons thoroughly familiar with the site, with state and local regulations, and with the plans of the builder. The regulations of local health authorities, stream pollution control agencies, lending institutions, and mortgage insurance agencies must be met. Where possible, a plan should have the provisional approval of regulatory and insuring agencies before heavy financial commitments are made.

Many highly technical decisions concerning the degree of treatment, effluent disposal, and method of treatment must be made before a plan can be drawn. The services of a sanitary engineer are needed to make the preliminary investigation, design the system, present the facts to the various authorities, and if one is used, to supervise construction and operation of the sewage treatment plant during its break-in period. He should be consulted at the start of the project as his early advice is important to the entire plan.

INDIVIDUAL SYSTEMS

The fourth general solution, providing individual treatment systems for each house with disposal of the treated liquid to storm drainage, is relatively new and may never receive general acceptance. As a practical matter it is necessary to concede that few home-owners can be trusted to operate a sewage treatment plant in such a manner that the treated liquid can be safely discharged directly to the environment. On the other hand, a fool-proof device capable of providing the high degree of treatment needed independent of disposal to the soil would be of tremendous value.

"On-lot" Disposal: The septic tank soil absorption system is the most widely used method of "on-lot" disposal. Under proper circumstances it can be a satisfactory method for disposal of sewage from individual houses in a developing suburban community, but it is expensive, and its successful use is subject to a number of stringent conditions. These conditions are described in detail in The Manual of Septic Tank Practice.(1)

The septic tank is a poor temporary facility, and it should never be used where conditions are improper for its successful operation. In many instances, septic tanks have been used and are being used where there is little chance of successful performance, on the assumption that adequate sewerage service will be provided as soon as the population density is sufficient to provide financing. Although in theory the temporary use of septic tanks may appear attractive, ample evidence can be found in blighted areas across the country to illustrate the falacy of that approach.

CONNECTING TO AN EXISTING PUBLICLY FINANCED SEWAGE SYSTEM

This method is by far the most satisfactory and generally the most economical one. For the builder, there are no worrisome and costly "call-backs", there are no operation problems, and there is no question of capital recovery. In most areas saleability of houses served by a central sewerage system is greatly enhanced. Since the solution is permanent, resentment caused by additional expense to the home-owner when a temporary scheme must be replaced is eliminated.

(1) Manual of Septic Tank Practice, U. S. Dept. of Health, Education, and Welfare, Public Health Service Publication No. 526, U. S. Government Printing Office, Washington 25, D. C. (Price 35 cents)

Even when the first cost of connecting to a public system is higher than some other scheme, this plan may be less expensive and more satisfactory in the long run. Local conditions usually make connection difficult, but the advantages are so important that the approach should not be abandoned until it has been thoroughly explored. Health authorities have a deep concern and heavy responsibility in this problem. By working together, builders and health departments may be able to accomplish what neither can accomplish alone.

Determine Availability of Existing System: In considering connection to an existing system, the first step is to determine availability of one with sufficient capacity for the additional load. If such a system is accessible, the proper authority should be supplied with an accurate estimate of the population to be served, the point or points at which connection to the system is desired, and the probable date of connection. Complete plans of the development showing all street sewers, laterals, and appurtenances should be furnished, and the authority should then be required to make an early determination in the matter. To prevent any possible misunderstanding at a later date, if the connection can be made, the builder should obtain a written commitment from a properly authorized person.

In most cases the tract sewers will eventually be dedicated to a governing body. In order to avoid delay and possible additional expense, the sewers should be constructed in accordance with local requirements. Prior approval of the plans and periodic inspection of the work by appropriate authorities during construction are desirable. In some cases it may be good business to contract with the authority for

construction of the main elements of the system. After construction is completed, the system should be transferred to the governing body as soon as arrangements can be made.

Financing: Financing is often the major obstacle to extension of public sewers. Although there are exceptions, it is generally conceded that the developer must install the house connections, street laterals, and collection sewers to serve the subdivision. Conflict usually arises over payment for the necessary off-site extension from the existing system to the subdivision, and for the extra capacity that may be required by future development. At this point tempers become short and negotiations often terminate abruptly. Actually, there are sound arguments on each side. Neither the builder, nor the first home-owners should be required to carry the full burden of improvements that will, in a matter of years, benefit the entire area. On the other hand, "tax-payers" of the existing community are sensitive to the use of their capital to extend services to a suburban development where the tax rate may be less than their own.

By calm and persistent effort, builders, administrators, and health authorities have been able to arrive at satisfactory financing arrangements. The possible approaches vary, depending on limitations imposed by law. One solution that seems to have merit is the "capital recovery" or "acreage fee" plan. The developer pays a flat fee of several hundred dollars per acre to the appropriate authority. The money is placed in a revolving fund and used to extend connecting sewers and to increase the capacity of the existing system to handle the additional load. Revolving funds for this purpose may also be replenished by lot assessments or front-foot charges.

Dry Sewers: A public sewerage system with ample capacity may be available but at such distance from the proposed subdivision that the cost of a connecting sewer is prohibitive. In such cases "dry-sewers" are sometimes used. As construction of the subdivision proceeds, a collection system is installed and carried to a point where a later connection can be made to a trunk sewer. A tap is made in the street sewer for each house and the house sewer is carried to a convenient point in the yard, but the actual connections are not made.

The builder is permitted to use septic tanks, but the lot-size is reduced to that required for a development with sewers. A fund to finance the extension of the trunk sewer is established by an assessment against each house or by an acreage fee arrangement. In making payment to the fund, the builder is given credit for excess capacity required in his street laterals to serve possible development of land above him on the watershed.

When sufficient funds are available or when the sewer authority deems it advisable the trunk sewer is extended to the subdivision. The home-owner then discontinues use of his septic tank and has his plumbing system connected to the sewer stub.

The advantages of this arrangement are apparent; however, it is workable only where the soil is suitable for septic tank operation. If the soil is unsuitable immediate failures will occur, creating health hazards and nuisances. The resulting complaints and unfavorable publicity can seriously interfere with the smooth development of the area.

Temporary Pressure Mains: In similar situations a pumping station and temporary pressure main are sometimes installed to carry the sewage to the established system. A collection system for the subdivision is installed at the time the houses are built and the sewage is carried by gravity to a pump station. The pump station should be so located that a convenient connection to the trunk sewer can be made at the time of extension.

Extension of the trunk sewer and provision of additional capacity in the collection system to provide for future growth are financed in the same manner as described for "dry-sewers". The builder is usually required to finance the temporary main and the pumping station. He must balance the cost of individual septic tanks against the cost of the pressure system. The expense and worry of operating a pump station may seem formidable, but these costs should be considered in relation to the less obvious but very real expense and worry of callbacks on malfunctioning septic tanks.

The pump station must be designed with care, and particular attention must be given to the length of time sewage is held in the wet well. If held too long, it becomes stale and odors may develop at the pump station or at the manholes in the vicinity of the connection to the existing system. It may be necessary to install a two-stage arrangement in order to maintain a short holding period at night and have capacity to handle peak flows during the day.

Where possible, it is generally advisable to turn the main and pump station over to an established authority. On the other hand

there may be reason to retain control of the facility while the area is developing. If the builder keeps control, he should compute the probable power and maintenance costs and establish an operating fund.

Cooperative Ventures: Where the cost of extending an existing system is too great for one builder, the project has been accomplished by joint venture. A group of cooperating builders may find it cheaper to construct the trunk sewer than to provide temporary facilities.

Under certain circumstances it may be feasible to organize a private company to take title to the collection systems and trunk sewer. The company charges each home owner a monthly fee for the service, and contracts with the existing authority to receive and handle the sewage. Other builders desiring to use the system are permitted to do so on payment of an appropriate fee and dedication of the tract sewers to the company. Eventually the system may be absorbed by a public authority and the company reimbursed for its investment.

CONSTRUCTING A PRIVATELY FINANCED COMMUNITY SYSTEM

In some rapidly developing residential areas there is no publicly financed sewerage system. In other situations existing sewers, especially in the upper reaches of the system, have insufficient capacity to carry additional loads. If a treatment plant is operating at or near its capacity, authorities may refuse additional connections until the plant is expanded. In still other cases the metropolitan area has outgrown the natural drainage basin, and new housing is being built on the reverse slope where logically a new system flowing in the opposite direction should be established.

Then too, the pattern of metropolitan expansion may limit the usefulness of the central sewerage system. In this age of private automobiles, cities no longer grow in tightly-knit concentric rings. Rather they send tentacles out into the countryside, leapfrogging in patchwork growth along major thoroughfares. Accomplishment of the long heralded Federal highway construction program will accelerate this pattern of ribbon like growth. With communities expanding radially along traffic arteries that cut across major drainage basins, it becomes difficult to justify the feasibility of extending central systems.

Under these circumstances, the small sewage treatment plant is useful as either an interim or a permanent installation. In a rapidly developing area, the eventual population density may justify a collection system and central treatment plant large enough to serve the entire drainage basin. If a master plan for such a central system is used as a guide, accomplishment of this eventual goal is simplified if the collection system and house connections are installed with each subdivision. The small sewage treatment plant can then be used as an interim measure until the large central system is constructed. With the small plant, sewage is brought to one point where it will be picked up by part of the larger system at a later date.

Where a possibility exists that a large area will not build up within a reasonable time, the small sewage treatment plant may be justified as a permanent solution. In considering permanent or interim arrangements, it should be remembered that a unified sewerage

system develops slowly. A plant that is installed as an interim device may be used for a considerable number of years before it is replaced. Therefore, authorities are justified in demanding sound design and careful construction.

Small Sewage Treatment Plants: Use of small sewage treatment plants in the manner indicated is a relatively new practice and there is little agreement on the factors involved. In general, knowledge and experience are not available to authorities to permit evaluation of the many claims of equipment manufacturers. Builders should give attention to information furnished by manufacturers, but they should not base health authority acceptance on that information alone. Advice from a competent sanitary engineer usually results in the most economical arrangement and selection of a scheme acceptable to the authorities.

The scheme employed will depend upon the degree of treatment needed, the size of the development, the rate of construction, and many other factors. A number of reliable manufacturers are producing plants for the "subdivision" market. Selected as the result of an engineering analysis and properly operated, these plants will give good results. They are compact, relatively easy to construct, and place the responsibility for equipment at one source. This last advantage can be of tremendous importance to the builder during the break-in period when adjustments are required.

Desirable Features: In general, a subdivision sewage treatment plant must produce a relatively clear, odorless effluent, low in solids and biochemical oxygen demand. As the plant will be located near homes

it must be free of odors, insects, and other nuisances. As a final safety precaution, disinfection of the effluent may become a common requirement.

To be of practical use, total cost of the sewage treatment plant and the collection system must compete with the total cost of individual septic tanks. Credit should be taken for the increased value of each house and the increased number of building lots per acre.

In spite of misleading claims, every sewage treatment plant requires regular maintenance for successful operation. Operating funds in most cases will come from a monthly fee of several dollars per home. If the maintenance cost is too great, the plant will be neglected and become inoperative. As the size of the plant and the number of homes served decreases, the operating budget decreases proportionately, but operational difficulties unfortunately remain the same or may even increase.

Regular maintenance depends on good design and a perpetual operating arrangement. If the plant is designed so that critical points are readily accessible they will probably receive attention. The human element and easy all weather access are important factors to consider in selecting the site of the plant. It is axiomatic that plants which can be seen by the public are well kept, while those in remote spots are often run-down.

Effluent Disposal: Historically, sewage treatment plants have been constructed near water to provide dilution for the plant effluent. In general, all-weather streams are not available to subdivisions, and there is no general agreement on the degree of treatment or the

safeguards required to render sewage fit for discharge to ground surfaces in inhabited areas. For these reasons acceptance of a sewerage scheme becomes more likely as the volume of dilution water at the plant outfall increases.

Availability of a suitable site may be the governing factor in the decision to use a small sewage treatment plant. The site must be acceptable to the discharge of effluent; it must be in the proper location in respect to drainage from the homes, and it must be large enough to provide a minimum distance between the plant and the nearest home. As the minimum distance is sometimes set as high as 1000 feet the investment in the site could be several times that of the plant. The advantage of seeking inexpensive land even though it may be some distance from the subdivision is apparent. The prudent developer will consider location and secure an option on a suitable site or perhaps several alternate sites before proceeding with his plan.

Stabilization Ponds: Sewage stabilization ponds are useful as either permanent or temporary facilities. They are capable of producing good effluent at low cost with minimum maintenance. Ponds require considerable area, recommended loading varying between 25 and 50 homes per acre of pond area, and a buffer zone of several hundred feet is usually required to encircle the pond. However, there is no minimum size and the land is salvageable so that temporary ponds are suitable for a pattern of stage construction. In one pattern a pond is constructed on the slope of a basin being developed. Houses are built above it until the available area is used. A new pond is then constructed downstream and the first pond is drained. In this manner

the basin is sewered as it develops and finally a large permanent pond or treatment plant can be built at the proper time in the proper location.

Private Sewerage Companies: Under certain circumstances private sewerage companies can be profitable arrangements. By constructing and operating a collection system and treatment plant a builder can provide sewers at the place and at the time they are needed. A large portion of the initial cost can be recovered from the sale of the houses served. Further recovery can be made from other builders who are allowed to tie into the system in consideration of an appropriate fee and dedication of the tract sewers to the company.

A reasonable monthly charge per home will provide for adequate operation and give some return on the investment. A major drawback in some instances has been the lack of an effective means for collecting delinquent accounts. Within the framework of appropriate laws, a collection procedure should be established that discourages delinquency and makes delinquent accounts readily convertible. Incorporation of the sewage charge with the water bill or with the monthly mortgage payment are two arrangements that have proved effective.

Eventually the area served by the sewerage system may be included in a municipality or sewer district. In that event the system may be sold to the public authority at its reasonable market value.

SUMMARY

In today's market a housing development without modern plumbing and sewage disposal would be a complete loss. In the present scheme, the home-builder is obligated to furnish the initial sewage disposal system just as he is required to furnish roads and other land improvements. For lack of a practical master sewerage plan, the builder is often forced into expensive, unworkable, makeshift arrangements. Invariably the builder is blamed when the home-owners face the inevitable inconvenience and expense of replacing inadequate systems. The orderly evolution of a satisfactory sewerage system is so dependent upon adequate plans, and the best interests of the house-building industry are so strongly involved, that every builder should exert all of the pressure at his command to see that a master sewerage plan which provides for the ultimate growth of the metropolitan area is developed in his community.

There are four common solutions to the problem of suburban sewage disposal. Although there is no general agreement on the acceptability of all of these methods, listed in order of usual preference they are:

(1) Connection to an existing publicly financed sewerage system.

(2) Construction of a privately financed community sewerage system.

(3) Construction of a treatment system for each house with "on-lot" disposal of the effluent in soil.

(4) Provision for an individual treatment system for each house with discharge of effluent to storm drainage.

The fourth system is relatively new and may never achieve general acceptance. The septic tank soil absorption system can be satisfactory if a number of stringent conditions are met. The community system has many advantages over individual facilities, but lack of fundamental knowledge results in a wide divergence of opinion concerning the design and usefulness of small sewage treatment plants.

Connection to an existing publicly financed sewerage system of sufficient capacity is generally the most economical and satisfactory means of sewage disposal. Even when the first cost of the connection is higher it is usually less expensive in the long run. By working together builders and health departments may be able to overcome obstacles which at first seem insurmountable and accomplish together what neither can accomplish alone.